

REMARKS

Claims 1-9 and 15-17 are active in this application, of which claims 1 and 15 are independent. Based on the following Remarks, Applicants respectfully request that the Examiner reconsider the outstanding rejection and they be withdrawn.

35 U.S.C. §103 Rejection

In the Office Action, claims 1-9 and 15-17 were rejected under 35 U.S.C. §103(a) for being unpatentable over U. S. Patent No. 5,180,690 issued to Czubatyj, *et al.* (“Czubatyj”) in view of U. S. Patent No. 4,885,614 issued to Furukawa, *et al.* (“Furukawa”). This rejection is respectfully traversed.

The invention is directed to increasing dopant (e.g., carbon or boron) concentration in a silicon or silicon germanium film at a low processing temperature. The invention reduces the partial pressure of the Si precursor, or, where Si and Ge precursors are used, of the Si and Ge precursors, such that reduction of film growth rate can be achieved. This reduction in the film growth rate permits increased dopant incorporation.

In the Office Action, the Examiner asserted that Czubatyj teaches carbon or boron-doping while *supplying a silicon precursor to a substrate*, particularly in column 11, line 16 and column 4, line 40. Again, Applicants disagree with the Examiner. For example, in column 4, Czubatyj discloses, in part,

“Typical dopant elements include phosphorous, boron, arsenic, aluminum, and combinations thereof. Typical precursor dopant gases include but are not limited to PH₃, PF₅, B₂H₆, BF₃, AsH₃, and combinations thereof” (column 4, lines 36-40).

However, “ PH_3 , PF_5 , B_2H_6 , BF_3 , AsH_3 and combinations thereof” is disclosed as a silicon precursor to the substrate, and, hence, column 4 does not teach carbon or boron-doping *while supplying a silicon precursor to a substrate.*

Also, Applicants do not only rely on the passage of column 4, but also bring the Examiner’s attention to column 11. In column 11, Czubatyj discloses an example of preparing doped polysilicon devices by low temperature process for the fabrication of the highly doped n+ type source and drain regions in thin film transistor devices.

Particularly in Example 1,

“The amorphous silicon alloy film was deposited using silane (SiH_4) *as the deposition gas*” (column 11, lines 16).

But, silane is used as the deposition gas to deposit the amorphous silicon alloy film, *not as a precursor*. Contrary to the Examiner’s argument on page 2 of the office action, the silane of Czubatyj is not equivalent to the silicon precursor of the invention. One of skill in the art would readily recognize that silane deposition is not a silicon precursor. Thus, the Examiner is respectfully misinterpreting the Czubatyj reference.

Additionally, column 11 further describes

“The reaction gas contains at least a precursor dopant gas and a diluent gas. The reaction gas employed herein comprises 98% hydrogen as the diluent gas, and 2% phosphine (PH_3) as the *precursor dopant gas*”.

It is clear that PH_3 is used as a precursor dopant gas, and silane is not a precursor dopant gas. If silane was to be used as a precursor, Czubatyj had ample opportunity to disclose such feature, but did not. Instead, Czubatyj mentions other precursors, which are the subject of such invention. Accordingly, Czubatyj does not disclose or suggest “carbon or boron-doping while

supplying a silicon precursor” for reducing film growth rate when growing a carbon or boron-doped silicon film.

Also, the Examiner again asserts that Czubatyj teaches carbon or boron-doping *at reduced pressure of about 0.1 to 100 millitorr* in column 11, line 23. This passage does not disclose carbon or boron-doping ... *at reduced pressure of about 0.1 to 100 millitorr*. Czubatyj describes, in column 11 depositing an amorphous silicon alloy film onto low temperature Corning 7059 Glass substrate in a hot wall, low pressure chemical vapor deposition reactor maintained at approximately 2 torr, and 550° C. Also, this passage discloses that the amorphous silicon alloy coated substrate was placed in an evacuable enclosure which enclosure was maintained at a pressure of 100 millitorr” (column 11, lines 10-23). Thus, Czubatyj fails to disclose the claimed feature of “carbon or boron-doping while supplying a silicon precursor and optionally a germanium precursor to a substrate, *at reduced pressure of about 0.1 to 100 millitorr*.

As previously argued, Furukawa fails to cure the deficiency from the teachings of Czubatyj. Particularly, Furukawa is silent as to “carbon or boron-doping while *supplying a silicon precursor* and optionally a germanium precursor to a substrate ...” as claimed. Since none of the cited references teach or suggest this claimed feature, it would not have been obvious to combine the teachings of the cited references to arrive at the claimed invention.

Further, claim 1 recites

“supplying a dopant precursor from a single source to the substrate at a substantially constant flow rate while lowering a flow rate of the silicon precursor”

The Examiner admitted “Czubatyj does not specifically disclose lowering the flow rate of the silicon precursor, whereby a concentration of the dopant in the substrate increases”.

Nevertheless, the Examiner has directed Applicants’ attention to col. 4, line 41 for the

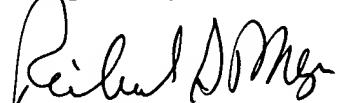
proposition that Furukawa shows such feature. However, Applicants merely note that col. 4, line 41 shows that the emitter layer 35 has an impurity concentration of 10^{19} cm⁻³. This is not the same or equivalent to the recited claimed feature.

Claims 2-9 that are dependent from claim 1 would be also patentable at least for the same reasons set forth above. Independent claim 15 would be also patentable since it includes many of the features of claim 1. Accordingly, Applicants respectfully request that the rejection over claims 1-9 and 15-17 be withdrawn.

CONCLUSION

In view of the foregoing remarks, Applicants submit that all of the claims are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicants hereby make a written conditional petition for extension of time, if required. Please charge any deficiencies in fees and credit any overpayment of fees to International Business Machines Corporation's deposit Account No. 09-0458.

Respectfully submitted,



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